VARIATIONS IN SURGICAL RATES AMONG THE ELDERLY POPULATION OF SOUTHWEST AND CENTRAL VIRGINIA

by

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Thesis submitted to the Faculty of the

Virginia Polytechnic Institute and State University

in partial fulfillment of the requirements for the degree of

Master

in

Urban Affairs

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August 11, 1987

Blacksburg, Virginia

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(ABSTRACT)

The purpose of this study was to examine variations in the surgical rates among the elderly population of hospital service areas of southwest and central Virginia in order to assess whether these variations were influenced by physicians and hospitals. Procedures analyzed were specific to the elderly. Considerable variations in the rates of the selected surgical procedures were found. Some areas were found to be surgically more active than others. The variables that proved to be determinants of surgical rates were availability of general physicians and specialists and hospital occupancy rate. The impact of availability of hospital beds, per capita expenditure and ownership status of facilities were found to be mixed and inconsistent.

Acknowledgements

I wish to thank Professor James Bohland for his constant help and advice. Without his encouragement and guidance as the Committee Chairman this thesis would have never seen the light of the day. I also wish to thank Professor Sara Rosenberry for providing moral support during moments of doubts. I am very grateful to Director of Southwest Virginia Health System Agency, who not only provided the data but also valuable insights into local conditions.

I particularly want to express my gratitude for the staff of the Virginia Tech Library and Computing Center for their friendly helpfulness. assisted with the typing of the manuscript. My friend, Dr. Usha Munshi, deserves a special mention for just being there. As for my husband, words can only partially express what I owe him.

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Chapter I

Introduction

Variations in surgical rates between population groups has been a topic of research since 1948, when a British health official found a tenfold variation, ranging from 40 to 440 per thousand, in the tonsillectomy rates of British children (Glover, 1949). Since then studies documenting variations in surgical rates between countries, provinces, and counties have been published (Hogan and Eimer, 1965; Pearson et al., 1968; Bunker, 1970; Dyck et al., 1977; Wennberg and Gittelsohn, 1982). The existence of surgical variations is now commonly accepted. However, their causes are still a matter of conjuncture. Surgical rate determinants have been examined in terms of family and individual ideas about health care, availability of health resources, and professional attitudes toward health care (Wennberg and Fowler, 1977; Roos and Roos, 1982). While there is little empirical evidence that individual physician characteristics such as type of residency or specialization exercise any influence on overall surgical process, arguments have been made in favor of health resources as determinants of surgical determinants (Vayda and Mindell, 1983). Varying medical judgements among physicians has also been cited as creating the variations (Bames et al., 1984). Whatever the explanations, the very existence of variations has raised questions of unnecessary surgery (Rutkow and Zuidema, 1978), over and under utilization of health services (Wennberg and Gittelson, 1973) and the cost-effectiveness of surgical therapeutics. As health care costs mount, surgical practices will be a primary target of cost control measures and in this context, determinants of surgical rates assume particular importance.

Most research on the subject has concentrated on the general population. Two important gaps in our understanding of surgical variations has resulted because of this: first, trends in surgical variations in the general population may not be reflective of the trends in specific population groups. Groups are at different risks in terms of surgical practices. Consequently, it is important that greater demographic control be introduced in order to account for differences in surgical risks

among demographic groups. Second, some of the variables used to test relationships in the general population are not always appropriate to use for a specific age group. Hospital insurance has been a frequently used variable to predict variations in surgical rates among the general population. However, it would not explain variations for the elderly, since there is a near universal Medicare coverage.

By concentrating on a specific age group and by testing relationship between surgical rates and selective hospital and physician variables, it is hoped that this study will provide answers to some hitherto unanswered questions. Unnecessary surgery and over and under utilization of health services are important issues in today's medical world for they add to the ever expanding cost of health care and may lead to a decline in the quality of care received by patients. In an atmosphere where a constant tussle between reducing costs and maintaining quality of care exists, applying cost control measures randomly will not achieve the desired objective. For this reason, it is important to pinpoint where surgical rates are significantly higher than might be expected to determine the extent to which the structure of the local health care system contributes to the higher rates.

Variations in surgical rates among the elderly population living in the geographic area covered by the South Western Virginia Health System Agency 3 are the focus of this study. As in previous studies (Wennberg and Gittelsohn, 1973) the analysis of unit in the hospital service area. This study addresses two research questions: (1) Are there significant variations in the surgical rates for the elderly in the hospital service areas of Southwest Virginia? (2) To what extent can variations be explained by the number of physicians, number of hospital beds, hospital occupancy rate, per capita expenditure, and ownership status. Regional variations in length of stay and rate of hospitalization among Medicare benefits are well documented (Rothberg (ed), 1982), but little is known about such variations in surgical rates within that population. Thus, this study will not only help increase our understanding of surgical variations in general, it will also add to our knowledge of how the medical system meets the needs of the elderly population in Southwest Virginia.

The remaining part of this study is divided into four chapters. The conceptual model and rationale for the study is discussed in Chapter 2. The methodology and the data for the study are reviewed in Chapter 3. Chapter 4 contains description of the major findings of the study. In Chapter 5, a discussion of the findings and its implications for future research activities is given.

Chapter II

Conceptual Model

A study of the records of the Blue Cross Association of the state of Kansas in 1960 was one of the first to examine spatial variation in surgical procedures (Lewis, 1960). This study found a three fold variation in surgical rates for tonsillectomy, cholecystectomy, and varicose vein stripping. These variations were shown to be related to the availability of physicians, surgeons, and hospital beds. This early study laid the foundation for future analyses of surgical rates. The basic approach in subsequent studies has been to: (1) identify whether per capita surgical rates of similar population groups exhibit significant variations, i.e., are some spatial units experiencing more surgeries than others; (2) determine whether these variations are related to structural characteristics of the medical service system, e.g, physicians, surgeons, hospital beds. Reasons for hypothesizing such association between surgical rates and structural characteristics of medical system are based on the unique market characteristics of the health care industry.

Physicians, Patients, and Health-Care Market

In a typical market situation, consumers know what they want because they have the knowledge of the utilities of the various goods and services they wish to buy and use this information to maximize their satisfaction within the market place. These conditions are not met in a medical market because the consumers do not possess the necessary information to define wants and needs. They cannot determine the value of goods or buy at the lowest prices, and the seller, a physician acts as an agent for the buyer. The physician defines needs and evaluates therapies and prices and makes vicarious utility judgements for the patient. This agency relationship is necessary and desirable because it is assumed that the patient does not have the benefit of a thorough medical training.

Physicians and Demand Inducement

The unique position in which the physician is placed in the health care market enables him to manipulate the market to his advantage if he desired. In a typical market when demand is constant, any increase in supply would shift the equilibrium to a point down on the demand curve. However, in a medical market, the physicians are able to prevent this downward shift by creating or inducing additional demand that could match up to the increase in supply (Fuchs and Kramer, 1972). Demand inducement occurs when a physician recommends or provides services that differ from what the patient would have chosen if he or she had available the same information and knowledge as the physician. Physicians induce demand for reasons that are primarily economic, i.e., to attain or maintain certain level of income. Many studies of demand inducement have examined how physician population ratios affect various outcomes such as price, output, and utilization. The argument is that if increases in this ratio lead to higher prices and higher income or higher output per physician then demand inducement has occurred. Studies which examined the supply of surgeons at different time periods found a positive relationship between physicians/population ratio and the number of operations performed (Fuchs, 1978; Cromwell and Mitchell, 1982). Positive association was also found in studies which analyzed physician population ratio and physician fees (Evans, 1974; Redish et al., 1981; Woodward et al., 1981). It was also found that when changes in Medicare reimbursement rates threaten to cut into physicians' income, the problem was overcome by ordering more highly intensive medical and greater quantities of surgical services (Hadley et al., 1979; Rice, 1983).

Similarly, studies that have examined supply of medical resources across spatial units have found utilization to be positively associated in the supply. Detmer's analysis of variation in surgical rates in the planning districts of Wisconsin found the variations to be positively correlated to the supply of physicians and surgeons (Detmer, 1979). Wennberg's classical study on surgical variations across small areas found a positive association between the variations and the availability of general physicians and surgeons (Wennberg, 1975). In Ontario, surgical variations across counties were found to be related to the supply of physicians and surgeons (Vayda and Stockwell, 1978).

These studies suggest that the presence of more physicians leads to more surgeries for the population.

It is clear from studies that have examined the phenomenon of demand inducement, both across time and space, that physicians have the unique ability to generate demand for their services, that whenever the supply of physicians increased use of their services also increased, and that where more physicians existed, more surgeries were performed.

Hospitals and Demand Inducement

Just as physicians can induce demand for services to acquire and/or maintain income level, hospitals induce demand to acquire and/or maintain revenues. The role of hospitals in demand inducement is less obvious because physicians and not hospitals make decisions about patients' hospitalization and therapeutical needs. Nonetheless, physicians are dependent on hospitals to provide certain diagnostic and surgical services for their patients. Hence, this dependency enables the hospitals to directly and indirectly influence physicians behavior. A hospital that suffers from low utilization (consequently low revenues) may exert pressure on the physicians to bring in more patients. The physicians may respond to the pressure because to a great extent the quality of care the physician gives his patients depends on the quality of care provided by the hospital to which he admits his patients . That physician respond to such administrative pressure is well indicated by studies which have analyzed hospital length of stay and physicians' hospitalization practices. Studies have shown that hospitals with lower occupancy rate usually have longer length of stay, and since physicians make decision about patients' length of stay in hospital, it is reasonable to conclude that such decisions are made partly on the basis of hospital's needs (Estaugh, 1980; Rafferty, 1971). Similarly, physicians practicing in areas with high bed to population ratios and low occupancy rates tend to be high users of hospitals both in terms of admissions and hospital days (Roos et al., 1986). Also, studies which have examined spatial variations in surgical rates found high rates of surgery to be associated with bed availability (Vayda and Stockwell, 1979). The findings of these studies indicate that physicians change or modify their practice styles to accommodate hospital needs.

There are also number of indirect ways through which hospitals influence physicians. One study reported that 54 percent of inappropriate patient hospital days of stay in Baltimore were related to delays in performing or receiving diagnostic test results (Estaugh, 1980). A physician is also forced to give expensive hospital services when the less expensive ones are not made available. Cataract surgery, for example, could be performed on both out patient and inpatient basis. But, by not making outpatient services available, a hospital can have the same surgery performed in a more expensive inpatient setting.

Critique of Existing Literature on Surgical Variations

Although much research has been completed on the problem of surgical variations, these studies fall short on two counts. First, so far only the number of physicians and hospital beds have been used as predictors of surgical rates (Lewis, 1969; Vayda, 1979). No attempt has been made to study the impact of some other hospital characteristics, e.g., occupancy rate of the hospital. A hospital's financial stability depends on maintaining a certain optimum level of occupancy rate. It is also well known that hospitals with low occupancy rate encourage longer length of stay as a means of enhancing their revenues. Whether a hospital with low occupancy rate would encourage more surgeries has not been explored at all. Again in recent times, proprietary hospitals have been a growing phenomena in the hospital scene. It is not known whether proprietary hospitals encourage more surgical utilization to increase their profits. This is yet another aspect that needs examination.

Earlier studies (Chapter 1) have examined surgical variations across spatial units for the entire population. Existing research does not tell us any thing about the pattern of variations that could exist within a specific age, racial, or income group. The range of variations found in the total population may or may not be the same for a specific population group, because groups have different discretionary surgical practices associated with them. For example, trussing is sometimes recommended for inguinal hernia repair among the elderly whereas it is always treated surgically among the young. Obviously, overall rates for the procedure will not reflect the differential rates between these groups.

Present Study

Present study examines the question of demand inducement in the form of surgical variations across spatial units in a specific population group. The population group under consideration is the elderly population of southwest and central Virginia. The demand inducement variables are physician supply, supply of hospital beds, hospital occupancy rate, per capita expenditure, and ownership characteristics.

Implication of Surgical Rate Variations for the Elderly

Variations in surgical rates have different implications for different age groups. For the elderly some surgery may be a matter of life and death. Other types of surgery, like lens extraction, offer the elderly the chance to function independently. Yet, the elderly succumb to post operative mortality more often than any other age group (Roos and Roos, 1984). Surgeries such as femur fracture reduction, hip arthoplasty and coronary artery bypass have especially high post-surgery death rates. femur fracture reduction, hip arthoplasty and coronary artery bypass. In some procedures such as prostatectomy death is a possibility even an year after the surgery (Lubitz et al., 1985). If we take into account the iatrogenic diseases the elderly are susceptible to, the physical costs of surgery for the elderly can be strong.

Then, there is a question of unnecessary surgery. Although opinions differ on what constitutes unnecessary surgery, consensus is that unnecessary surgery exists (Rutkow, 1982). The extent of unnecessary surgery is also not known. For example, it was estimated by the Moss subcommittee that in 1974 alone 2.4 million unnecessary surgeries were performed at a cost of $4 billion leading to 11900 unnecessary deaths. In as much as wide differences in hospitalization and surgery among apparently similar population is uncorrelated with comparable differences in the incidence of disease, one is forced to conclude that some populations are getting more medical care than they need (Wennberg, 1979). Given the susceptibility of elderly to post operative infection and death, needless surgery exposes the elderly to unnecessary risk of disease and death.

The impact of the variations on health care cost is tremendous. One study calculated the expenditures associated with seven specific surgical procedures for the United States based on per capita rates of surgery observed among different health regions of United Kingdom and Canada (Wennberg, 1982). If surgery rates that were found in the low rate regions in the United Kingdom were the norm for United States, United States would save $3.0 billions annually over current expenditures. Cost saving is particularly critical for Medicare because it is a federally administered program is a frequent target of cost control measures, the Diagnostic Related Groups (DRG) being the most recent example. Until now, most medicare cost control measures had been directed at the consumers (i.e., the elderly) taking the form of increased copayments and deductibles. Prospective payment is the first major reimbursement policy change targeted at the providers of medical services, in this instance, the hospitals. Briefly put, under the prospective payment system known as DRGs, each hospital will receive a prospectively determined rate for each procedure regardless of the costs the hospital actually incurs. For hospitals in which Medicare reimbursements form a substantial portion of hospital revenues, DRGs may bring about a drastic change in the way they do business. Already, many preliminary studies are suggesting that the implementation of DRG would force hospitals to encourage those treatments that are revenue enhancing and discourage those treatments that are unprofitable (Stemson, 1986). If this happens then there could be considerable change in the variations of surgical procedures. A pre DRG study on surgical variations such as this, will be useful for comparison with post DRG surgical practices. With such a comparison assessment of the impact of DRG based payment system has on surgical practices can be assessed.

Chapter III

Methodology

Purpose of Study

The purpose of this study was to examine spatial variations in surgical rates among the elderly population of central and southwest Virginia for the year 1981 and to determine if the variations were influenced by physician supply, supply of hospital beds, hospital's occupancy rate, per capita expenditure and ownership status.

This study addressed three major research questions:

1. What was the degree of variation between areas for each selected procedure?
2. Did physicians supply influence surgical outcomes?
3. Did hospital's bed supply, occupancy rate, per capita expenditure and ownership character influence surgical rates?

Hypothesis

It was hypothesized that there would be significant variations in surgical rates among the elderly population and that bed supply, physician supply, hospital's occupancy rate, per capita expenditure and ownership status would help explain these variations.

The hypothesized relationships were as follows:

1. There would be a positive correlation between number of physicians and number of surgeries. In areas with more general physicians performing surgeries and with more specialists there would be more surgeries.

2. Areas with higher bed/population ratio would experience more surgeries. This is the test of Roemer effect; i.e., surgical utilization increases with bed supply.
3. Areas with low hospital occupancy rate would experience more surgeries. It is hypothesized that hospitals with a low occupancy rate would use surgeries to enhance their revenues.
4. In areas in which hospitals had higher per capita expenditures surgical rates would be higher.
5. Areas in which proprietary hospitals were present in significant numbers would experience more surgeries.

Data Sources

Data for surgical rates were made available by the South-West Virginia Health System Agency from Professional Services Review Organization (PSRO). The PSRO program was originally created by the federal government to assure that health care services funded under Medicare and Medicaid systems were necessary and appropriate. It imposed on hospitals a requirement for concurrent admission and length of stay review of each Medicare/Medicaid patient by the PSRO. It was a peer review organization composed of physicians and hospital administrators, and hence PSRO accepted the reports of the hospital at their face value and usually did not challenge the accuracy of the reports. Also, the number of patients whose admissions were disallowed were extremely small. These facts have to be remembered when using the PSRO reports.

The Southwest Virginia Health System Agency has jurisdiction over twenty-seven counties in southwest and central Virginia and these counties comprised the study area (Table 1). PSRO records used in the analysis contained patient discharge data from those hospitals in the region that were within its jurisdiction (Table 2 and Map 1). Discharge data contained information on a patient's age, sex, place of origin, hospital where treatment was received, diagnoses, procedures, length of stay and the source of payment (Table 3). If a resident of the study area received treatment in a hospital outside the study area, surgical information on that patient would be unavailable. The absence of data from hospitals outside the study area could lead to an underestimation of surgery. However, the underestimation was believed to be small because the surgical procedures analyzed were not complicated and normally would not require a large research hospital.

Table 1

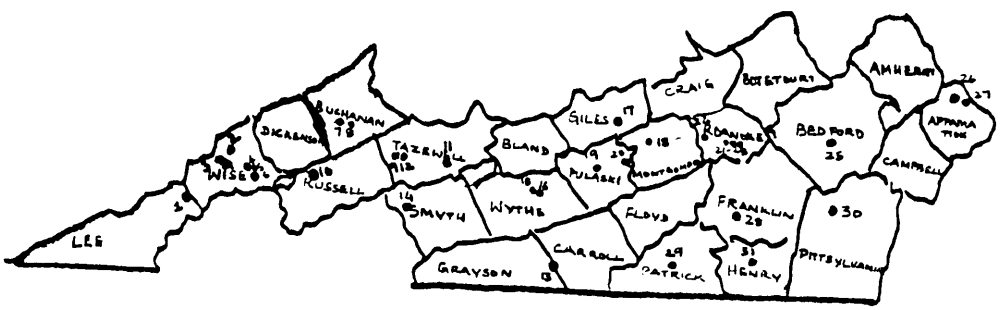
Study Area - Counties and Cities

Planning District	County/City
1	Lee
	Wise
	Norton
2	Buchanan
	Dickenson
	Russell
	Tazewell
3	Bland
	Carroll
	Grayson
	Galax
	Smyth
	Wythe
4	Floyd
	Giles
	Montgomery
	Pulaski
	Radford
5	Alleghany
	Botetourt
	Craig
	Clifton Forge
	Covington
	Roanoke
	RoanokeCity
	Salem City
11	Amherst
	Appomattox
	Bedford
	Cambell
	Bedford City
	Lynchburg
12	Franklin
	Henry
	Patrick
	Pittsywania
	Danville
	Martinsville

Table 2

List of Hospitals

Hospital No.	Hospital Name
1	Lee County Hospital
2	Lonesome Pine Hospital
3	Wise ApplachianRegional Hospital
4	Norton Community Hospital
5	St. Mary's Hospital
6	Park Avenue Hospital
7	Buchanan General Hospital
8	Grundy Hospital
9	Humana Clinch Valley Hospital
10	Russell County Medical Center
11	Tazewell Community Hospital
12	Mattie William Hospital
13	Twin County Hospital
14	Smyth County Hospital
15	Wythe County Hospital
16	Wytheville Hospital
17	Giles Memorial Hospital
18	Montogomery Hospital
19	Pulaski Community Hospital
20	Radford Community Hospital
21	Gill Memorial Hospital
22	Community Hospital of Roanoke Valley
23	Roanoke Memorial Hospital
24	Lewis Gale Hospital
25	Bedford County Hospital
26	Lynchburg General Hospital
27	Virginia Baptist Hospital
28	Franklin Memorial Hospital
29	R. J. Reynolds Hospital
30	Memorial Hospital of Danville
31	Memorial Hospital of Martinsville and Henry County



*Hospitals (see Table 3)

Figure 1. Map of Counties and Hospitals

Table 3

PHDDS Record, 1981

xxxx	yyyy
1	Birthdate
2	Sex
3	Race
4	Zip
5	Hospital Indicator
6	Admission Date
7	Discharge Date
8	Diagnoses (Principal and Secondary up to 5)
9	Procedures (Principal and Secondaries up to 4)
10	Patient Disposition
11	Pay source
12	Length of Stay

Data on number of beds and per capita hospital expenditure were obtained from Annual Survey of Hospitals files maintained by the Southwest Virginia Health System Agency. The files contained information on number of beds, admissions, discharges, surgical procedures, patient days and total expenditure for each hospital. The information on ownership and occupancy rate were gathered from the American Hospital Association Guide for the year 1981. Information on physicians and specialists were gathered from the Roster of Registered Practitioners of Healing Arts (Virginia Board of Medicine, 1980).

Population Based Analysis

Population based health analysis has its origin in classical epedemiology where the distribution of costs, services, diagnoses and surgical procedures are normally examined on a per capita basis. De jure surgery data (one based on the residence of the patient) provide better index of health care consumption within a community than do defacto reporting of medical care that is based on the location of hospitals or individual physicians. De jure location was used because (1) most of the surgery used in the study could be done locally so that de jure and defacto location would be

identical in most cases; and (2) the decision to have surgery is usually made by the patient in conjunction with a community physician.

Unit of Analysis

The unit of analysis for the study is the hospital service area. This is consistent with most other studies of small area surgical variations (Wennberg, 1973). The service areas were constructed from data on: the patient's place of residence by zip code and the hospital where treatment was received. Based on PSRO files, the hospital where the majority of residents in a zip code unit received treatment was determined. Zip code areas with similar hospital use patterns were combined to form a hospital service area. Twenty-three hospital service areas were thus identified. When two or more hospitals situated in the same general location had equal share of patients from the same area, the service areas of the hospitals were combined to form one hospital service area. Of the twenty hospital service areas in the region, six were served by more than one hospital (Table 4).

Table 4

Hospital Service Areas Served by More than One Hospital

Hospital Service Area	Hospitals	Location
HSA3	St. Mary's Hospital, Park Avenue Hospital, and Norton Community Hospital.	Norton
HSA6	Buchanan General Hospital, and Grundy Hospital.	Grundy
HSA5	Humana Hospital, and Mattie William Hospital.	Clinch Valley
HSA11	Wythe County Hospital, and Wytheville Hospital	Wytheville
HSA16	Roanoke Memorial Hospital, Community Hospital of Roanoke Valley, and Gill Memorial Hospital.	Roanoke
HSA19	Lynchburg General Hospital, Virginia Baptist Hospital	Lynchburg

Study Area

Socio Economic Characteristics

The twenty-seven counties which formed the study area were mostly rural in character (Table 5). Eleven had no urban population at all and of the remaining fifteen only three had more than 50 percent of their population living in urban areas. The size of the elderly population in most cases was not more than 11 percent. For most areas percent of the elderly ranged from 8.5 percent (Campbell) to 13 percent (Carroll) of the total population. The counties generally had low per capita incomes and more than 10 percent of their population living below poverty line. Mining was the primary occupation for six counties while manufacturing was the main industry for twenty-three counties.

Hospital & Physician Characteristics

The hospitals in the study area varied in size, ranging from a low of 60 beds to a high of 682 beds. The occupancy rate ranged from 41.8 to 87 percent. Thirty-three percent of the hospitals were proprietary hospitals (Table 6). For the hospitals most admission came from the residents within their service areas. Except for service area 4, more than 55 percent (Table 7) and as high as 98 percent of the admissions to the hospitals were from the residents within their service areas.

Table 5

Socio Economic Characteristics of the Region

Counties (U/R)	% of Population Over 65	Per Capita Income	Below Poverty	Primary Occupaion of the Labor Force
Alleghany R	10.6	6085	10.0	Manufacturing
Amherst (50 U)	10.4	5752	10.6	Manufacturing
Appamattox R	12.3	6233	10.6	Manufacturing
Bedford R	11.4	6171	9.3	Manufacturing
Botetourt R	10.5	6762	7.7	Manufacturing
Buchanan R (7.1 U)	6.8	5444	18.8	Manufacturing
Campbell R(5.6 U)	8.7	6333	9.5	Mining
Carroll R	13.7	4998	16.1	Manufacturing
Craig R	12.9	5481	10.2	Manufaccturing
Dickenson R	9.4	5151	17.9	Mining
Floyd R	15.6	5186	15.4	Manufacturing
Franklin (11.70)	10.9	5674	10.3	Manufacturing
Giles (141 U)	12.0	5640	12.5	Manufacturing
Grayson R	14.3	5266	14.0	Manufacturing
Henry (19.4 U)	8.5	6033	9.8	Manufacturing
Lee R	13.9	4540	25.9	Mining
Montgomery (64.5 U)	6.9	5657	19.7	Manufacturing
Patrick R	13.3	5561	13.1	Manufaccuring
Pitsylvania (13.9 U)	10.8	5643	15.1	Manufacturing
Pulaski (28.7 U)	11.3	5822	11.0	Manufacturing
Roanoke (72.9 U)	9.6	8088	5.8	Manufacturing
Russell (11.1 U)	10.1	5388	14.8	Mining
Smyth (21.1 U)	12.7	5271	13.7	Manufacturing
Tazewell (39.4 U)	10.1	5786	14.3	Mining
Wise (25.7 U)	10.4	5725	15.4	Mining
Wythe (12.7 U)	28.06	5579	13.8	Manufacturing
Cities				
Bedford Ciy U	23.6	6120	15.2	Manufacturing
Clifton Forge U	21.6	6102	15.5	Manufacturing
Covington City U	17.7	6021	12.4	Manufacturing
Danville City U	15.4	6508	13.8	Manufacturing
Franklin U	12.8	5992	22.1	Manufacturing
Galax U	17.8	6624	15.4	Manufacturing
Lynchburg U	?	6896	13.1	Manufacturing
Martineville U	15.5	6789	13.3	Manufacturing
Norton U	12.7	6250	18.8	Mining
Radford U	9.1	5878	14.0	Manufacturing
Roanoke U	15.6	6816	16.3	Manufacturing
Salem U	13.0	7590	7.7	Manufacturing

Table 6

Hospital Characteristics

(1980-81)

Hospitals serving the Area	HSA	Beds	Occupancy Rate	Per Capita Expenditure	Ownership
Lee County Hospital	1	74	81.1	109	NFP
Lonesome Pine Hospital	2	60	78.3	312	NFP
Norton, St. Mary's & Park Ave.	3	269	72.9	151	NFP
Wise Hospital	4	67	86.6	352	NFP
Mattie Williams & Human Clinch	5	211	-	232	P
Buchanan General & Grundy Hospital	6	194	-	232	NFP39
Tazewell Community Hospital	7	50	78.0	160	NFP
Russell County Medical Center	8	78	69.2	219	P
Smyth County Medical Center	9	156	69.2	177	NFP
Twin County Hospital	10	144	78.5	196	NFP
Wythe County and Wytheville Hospital	11	153	66.7	168	NFP
Giles Memorial	12	65	41.5	232	NFP
Montgomery Hospital	13	146	62.3	276	P
Pulaski Community Hospital	14	153	78.5	-	P
Radford Community Hospital	15	175	69.1	256	NFP
Roanoke, CHRV, & Gill Memorial	16	1105	68.2	220	NFP
Lewis Gale Hospital	17	320	86.9	181	P
Bedford County Hospital	18	178	79.2	403	NFP
Lynchburg General & Virginia Baptist Hospital	19	682	84.3	343	NFP
Franklin Memorial Hospital	20	62	54.8	255	NFP
R. J. Reynolds Hospital	21	77	59.7	225	NFP
Danville Memorial	22	455	87.0	188	NFP
Memorial Hospital of Martinsville and Henry Co.	23	223	82.5	212	P

Table 7

Admissions by Hospital in Area and Residential Status

Hospital Serving the Area	HSA	Admissions to Hospitals in Area		
		Total Number	Residents	Non-residents
Lee County Hospital	1	702	97.57	2.43
Lonesome Pine Hospital	2	384	80.98	19.02
Norton, St. Mary's & Park Av.	3	1284	74.46	25.54
Wise Hospital	4	587	33.21	66.79
Mattie Williams & Human Clinch	5	1380	82.17	17.83
Buchanan General & Grundy Hospital	6	1062	91.61	8.39
Tazewell Community Hospital	7	491	84.72	15.08
Russell County Medical Center	8	520	91.92	8.08
Smyth County Medical Center	9	1177	88.44	11.56
Twin County Hospital	10	1336	96.03	3.97
Wythe County and Wytheville Hospital	11	1066	89.49	10.51
Giles Memorial	12	413	98.06	1.94
Montgomery Hospital	13	1375	80.21	19.79
Pulaski Community Hospital	14	931	81.84	18.16
Radford Community Hospital	15	1512	54.96	45.04
Roanoke, CHRV, & Gill Memorial	16	5260	58.06	41.94
Lewis Gale Hospital	17	2313	61.52	38.48
Bedford County Hospital	18	669	86.39	13.61
Lynchburg General & Virginia Baptist Hospital	19	3807	95.16	4.84
Franklin Memorial Hospital	20	649	91.21	8.79
R. J. Reynolds Hospital	21	770	96.88	3.12
Danville Memorial	22	2845	97.64	2.36
Memorial Hospital of Martinsville and Henry Co.	23	1043	86.86	13.14

There was considerable disparity in the distribution of health resources between hospital service areas (Tables 6 and 8). Hospitals located in urban areas were bigger in size and offered more services. Roanoke Memorial, Community Hospital of Roanoke Valley, Lewis Gale Hospital, Lynchburg General, Danville Memorial and Memorial Hospital of Martinsville had more than 200 beds. Some of the urban hospitals offered more sophisticated services such as post operative intensive care. Rural hospitals in contrast were smaller with less than 100 beds on the average and most of them offered only essential services, e.g., Lee County Hospital, Lonesome Pine Hospital, Wise General, Tazewell Community Hospital. Most hospitals in the study area had less than optimal occupancy rate. Of the 31 hospitals included in the study only six had more than 80 percent

occupancy rate. Occupancy rate for eleven of the hospitals was less than 70 percent (considered suboptimal by most economists and policymakers).

There were substantial differences in the numbers of general physicians and specialists within the service areas. The urban service areas had substantially higher number of general physicians and specialist per capita. The areas served by city hospitals such as Roanoke Memorial, Lynchburg General, Martinsville Memorial also had a greater variety of specialists. Some specialties were more widespread than others. For example, gynecologists were more frequent and were widely dispersed among hospital service areas than urologists and cardiologists, for example.

Selection of Procedures

In selecting surgical procedures for analysis only those procedures common to the elderly were considered. Those chosen were prostatectomy, hysterectomy, cholecystectomy, lens extraction, total hip replacement, inguinal hernia repair and pacemaker insertion. Table 13 describes the classification of these procedures according to their discretionary nature. The classification of the procedures is based in American Medical Association Guide on Health and Diseases and studies by Wennberg (Wennberg and Gittelsohn, 1975); Roos and Roos, 1977) and Vayda (Vayda et al., 1979). A surgical procedure was classified discretionary when surgery was only one of several recommended ways of treating the medical problem. Inguinal hernia repair is a nondiscretionary procedure by this definition since surgery is the recommended form of therapy for displaced hernia (AMA Guide, 1981). Hysterectomy was categorized as discretionary since surgery is only one form of treatment for the disease of the uterus except in case of cancer of the organ (Vayda, 1982). Lens extraction was classified a discretionary procedure because glasses are sometimes recommended for the cataract of the eyes. Since broken hips can be treated surgically or through traction of the leg it was classified a discretionary procedure. Pacemaker insertion and cholecystectomy were also classified as discretionary procedures. Insertion of pacemakers to regulate heartbeat is an optional procedure, depending on the severity of the case. This distinction between elective and nonelective procedures is particularly critical for demand inducement. Unnecessary surgery is more likely in diseases for which several forms of therapies are possible.

Table 8

Number of Surgeons and Physicians

Hospital Serving the Area	HSA	General Physician	Opthal-malogists	Cardio-logists	Orthopedi-cians	Urologists	Gynecologists
Lee County Hospital	1	7	1	1	1	-	-
Lonesome Pine Hospital	2	2	-	-	-	-	-
Norton, St. Mary's & Park Av.	3	6	1	-	4	1	3
Wise Hospital	4	7	-	-	-	-	- -
Mattie Williams & Human Clinch	5	3	-	-	-	1	4
Buchanan General & Grundy Hospital	6	8	-	-	-	-	1
Tazewell Community Hospital	7	9	-	-	-	-	-
Russell County Medical Center	8	5	-	-	-	-	-
Smyth County Medical Center	9	12	1	-	1	1	-
Twin County Hospital	10	18	1	-	1	1	2
Wythe County and Wytheville Hospital	11	11	-	-	-	-	2
Giles Memorial	12	7	-	-	-	-	1
Montgomery Hospital	13	24	3	-	2	1	4
Pulaski Community Hospital	14	7	-	1	-	1	1
Radford Community Hospital	15	10	1	1	1	2	5
Roanoke, CHRV, & Gill Memorial	16	55	16	6	11	-	23
Lewis Gale Hospital	17	1	2	3	1	4	
Bedford County Hospital	18	11	-	-	-	-	-
Lynchburg General & Virginia Baptist Hospital	19	47	9	1	10	6	15
Franklin Memorial Hospital	20	12	-	-	-	-	-
R. J. Reynolds Hospital	21	6	4	2	4	7	4
Danville Memorial	22	12	-	-	-	-	-
Memorial Hospital of Martinsville and Henry Co.	23	14	3	-	4	1	4

For the seven procedures that were examined, more than 50 percent and up to 97 percent of the population of hospital service areas went to their area hospitals (Table 9). The two marked exceptions were HSAS 12 and 20 served by Giles Memorial Hospital and Franklin Memorial Hospital respectively. One possible explanation could be that for the Giles County population, the adjacent Montgomery County Hospital with its concentration of specialists and service was a better place to go for treatment. Similarly, Franklin County residents probably preferred to utilize the superior services of the Roanoke hospitals for surgical treatments.

Data Analysis

Two types of analysis that were performed. First, variations in surgery rates for the seven procedures were analyzed. Rates for each procedure was age and sex adjusted by the direct method. The surgery rates for prostratectomy were calculated using the male population while the surgery rate for hysterectomy was calculated using the female population.

For variability, two measures, extremal quotient and standard deviation were used. Traditionally, "extremal quotient" which is the ratio of the highest to the lowest rate had been used to measure variability of a surgical procedures (Rothberg, 1981). However, the extremal quotient has one disadvantage in that it is computed from just two points in the distribution and consequently falls to incorporate information concerning variations across the distribution. Measures of variations that take into account position all the rates also is needed. For this reason standard deviations were used as an indicator of variability, the higher the standard deviation of the procedure greater the variability.

Table 9

Surgical Treatment by Area of Residence

Hospital Serving the Area	HSA	Percent Local Population
Lee County Hospital	1	55
Lonesome Pine Hospital	2	82
Norton, St. Mary's & Park Av.	3	70
Wise Hospital	4	62
Mattie Williams & Human Clinch	5	77
Buchanan General & Grundy Hospital	6	60
Tazewell Community Hospital	7	60
Russell County Medical Center	8	61
Smyth County Medical Center	9	60
Twin County Hospital	10	63
Wythe County and Wytheville Hospital	11	55
Giles Memorial	12	10
Montgomery Hospital	13	55
Pulaski Community Hospital	14	79
Radford Community Hospital	15	66
Roanoke, CHRV, & Gill Memorial	16	70
Lewis Gale Hospital	17	72
Bedford County Hospital	18	60
Lynchburg General & Virginia Baptist Hospital	19	95
Franklin Memorial Hospital	20	11
R. J. Reynolds Hospital	21	50
Danville Memorial	22	97
Memorial Hospital of Martinsville and Henry Co.	23	88

Multiple regression which was used to test relationships between independent variables and surgical rates. Independent variables were number of physicians, number of hospital beds, occupancy rate of the hospital, hospital's per capita expenditure and ownership character (Table 10).

Multiple regression model had the following form:

$$Y_i = f(X_{i1}\ X_{i2}X_{i3}X_{i4}X_{i4}\ )$$

where Y_i = elderly surgical rate in area i

X_{i1} = number of short term hospital beds per thousand in area i

X_{i2} = percentage occupancy in short stay hospital in area i

X_{i3} = hospital expenditure per patient day

X_{i4} = number of physicians per thousand elderly

X_{i5} = proprietary/non proprietary hospital

Table 10

Variables and Their Measurements

Variable	Measurement
Dependent	
Surgical rates for each procedure	Total operations per thousand elderly population
Independent	
Beds	Short term hospital beds per thousand elderly population
Occupancy	Percentage occupancy in short stay hospitals
Percapita expenditure	Hospital expenditure per patient day
Physicians (General Practioners and Specialists)	Number of physicians per thousand elderly
Ownership	Proprietory = 1 Nonproprietory = 0

Chapter IV

Results

Section I

A. Surgical Variations in Hospital Service Areas

There was a widespread variation in the rates at which each of the study procedures was performed in the service areas (Table 11). Three procedures, total hip replacement, pacemaker insertion and inguinal hernia repair, did not occur in several of the hospital service areas. Since inguinal hernia repair was a nonelective procedure, its absence might have been due to the lack of conditions which necessitate the procedure. Reason for the nonoccurrence of total hip replacement and pacemaker insertion are not clear but it may have been due to the small number of cases for such procedures (Table 12).

The standard deviation and the extremal ratio for the study procedures (except total hip replacement) conformed to the expected pattern. Hernia repair, a non-discretionary procedure had the lowest standard deviation. Hysterectomy, prostatectomy, lens extraction, cholecystectomy and pacemaker insertion being discretionary procedures had higher standard deviations.

Similarly, hernia repair being a non-elective procedure ranked lowest (except total hip replacement) in the order of ratios. All the other five procedures ranked higher.

One unexpected result was the low standard deviation and the low extremal quotient found for total hip replacement which was an elective surgical procedure. A possible explanation could be the extremely low number of cases found for this procedure producing somewhat deviant results. Since other elective procedures conformed to the norm the results of the total hip replacement could be regarded as an exception to the rule.

Table 11

Rates for Surgical Procedures

Hospital Serving the Area	Hystere-ectomy	Prostat-ectomy	Unilateral Inguinal Hernia Repair	Lens Extrac-tion	Cholecyst-ectomy	Pace Maker Insert-tion	Total Hip Replace-ment
1	1.04	3.11	3.45	2.26	2.14	2.28	X
2	5.88	29.28	6.57	4.95	1.14	X	X
3	1.39	14.73	2.93	5.19	3.12	.84	.57
4	1.67	15.81	2.20	2.24	10.44	X	X
5	1.68	14.17	1.13	4.64	4.63	3.49	.77
6	1.75	13.86	1.19	2.75	1.89	1.02	X
7	1.29	2.89	1.60	3.00	2.81	2.43	.35
8	1.94	6.16	.75	4.84	2.24	X	.80
9	1.40	11.69	1.74	2.94	4.05	2.41	.41
10	1.79	12.30	X	7.93	3.57	2.51	2.50
11	4.5	15.41	2.12	5.78	1.78	3.44	X
12	1.93	17.56	.94	7.13	1.48	.37	.43
13	1.32	4.73	3.89	7.59	3.23	3.85	2.23
14	2.85	6.03	3.66	6.65	5.65	4.55	.64
15	1.00	13.82	2.11	11.49	3.95	4.76	.30
16	1.51	15.93	2.71	6.60	2.94	1.94	.75
17	2.33	17.32	1.98	9.08	3.37	2.31	.86
18	4.12	19.62	2.36	9.45	2.42	.45	1.00
19	1.79	12.07	2.70	7.95	3.65	1.23	.76
20	1.92	19.49	1.59	3.03	3.41	4.80	X
21	3.01	9.16	X	1.23	1.70	2.48	1.18
22	2.37	9.15	.84	8.51	4.18	1.91	.45
23	1.61	18.43	2.09	8.02	4.49	1.14	1.56

X = No data

Table 12

Total Number of Cases for Each Procedure

1. Total Hip Replacement	84
2. Hysterectomy	135 (For women population)
3. Pacemaker Insertion	234
4. Hernia Repair	289
5. Cholecystectomy	402
6. Prostatectomy	669 (for men population)
7. Lens Extraction	834

One significant fact that emerged from the data analysis was the size of the difference between the lowest and highest rate for each procedure. For example, there was more than fourteenfold difference in the rate at which hysterectomy was performed in the hospital service areas. The difference was thirteenfold in cases of cholecystectomy and twelvefold in pacemaker insertion.

Table 13

Variations in Surgical Rates

Surgical Procedure	Highest Rate	Lowest Rate	Median	Ratio of Highest to Lowest	Standard Deviation
Total Hip replacement*	2.50	.30	.75	8.3	.56
Inguinal Hernia repair	6.57	.75	2.11	8.7	1.25
Lens Extraction*	11.49	1.23	6.19	9.3	2.72
Prostratectomy*	29.28	3.89	13.81	9.5	1.53
Pacemaker Insertion*	4.80	.37	2.31	12.9	1.53
Cholecystectomy*	10.44	.75	3.17	13.9	1.94
Hysterectomy*	5.88	.40	1.79	14.5	1.30

*Elective Procedure

B. Surgical Activity Among Hospital Service Areas

Total surgical activity in the twenty-three hospital service areas were analyzed to consider the possibility if surgery was more common in some areas than others. To determine if communities were characterized by high incidence of many procedures or the reverse, an overall rate of surgical

activity was calculated by adding the rates of seven procedures for each service area (Table 14). In aggregate, some areas were characterized by extremely low rates and some by extremely high rates. There was more than threefold variations between the highest (HSA2 served by Lonesome Pine Hospital) and the lowest rate (HSA1 served by Lee County Hospital).

Table 14

Surgical Activity in Hospital Service Areas

Rank (Highest to Lowest)	Hospital Service Area	Hospital Serving the Area	Total Surgical Activity
1	2	Lonesome Pine Hospital	47.82
2	18	Bedford Hospital	39.42
3	15	Radford Community Hospital	37.43
4	23	Martinsville Memorial	37.34
5	17	Lewis Gale Hospital	37.24
6	20	Franklin Memorial	34.24
7	11	Wythe County & Wytheville Hospital	33.12
8	16	Roanoke Memorial, Giles Memorial and Community Hospital of Roanoke Valley	32.38
9	4	Wise Hospital	32.36
10	10	Twin County Hospital	30.61
11	5	Mattie William & Humana Clinch	30.51
12	19	Lynchburg Memorial & Virginia Baptish Hospital	30.14
13	14	Pulaski County Hospital	30.03
14	12	Giles Memorial	29.48
15	3	Norton, St. Mary's & Park Avenue Hospital	28.68
16	22	Danville Memorial	27.41
17	13	Montgomery County Hospital	26.84
18	9	Smyth County Hospital	24.61
19	6	Buchanan General & Grundy Hospital	22.58
20	21	R. J. Reynolds Hospital	18.76
21	8	Russell County Medical Center	16.74
22	7	Tazewell Community Hospital	14.37
23	1	Lee County Hospital	14.28

Median Rate (30.30)

Areas with overall high surgical activity had high rates for most of the procedures while areas with low overall rate of surgical activity had low rates for most of the procedures (Table 15). (High or low rates were classified by values that fell above or below the median.) For instance, HSA18 (served by Bedford Hospital) which was second highest in total surgical activity had high rates for hysterectomy, prostatectomy, lens extraction, hernia repair and total hip replacement. Similarly, HSA15 (served by Radford Hospital) which was third highest in total surgical activity had high rates

for prostatectomy, hernia repair, lens extraction, cholecystectomy and pacemaker insertion. HSA1 (served by Lee County Hospital had lowest surgical activity and had the lowest rates for hysterectomy, prostatectomy, lens extraction, cholecystectomy and pacemaker insertion. These findings not only contrast findings in other studies they also negate the concept of "surgical signatures," according to which each service area is characterized by a predominance of one type of surgery over another (Wennberg, 1979). The emergence of "surgical signatures" of service areas is seen to be a product of the clinical decision made by a small number of physicians. Since the pattern of "surgical signatures" is not observed in the current study, the answers to wide variations in surgical utilization among similar and neighboring areas (such as HSAs 1 and 2, HSAs 23 and 21) cannot be found in the practicing style of one type of specialists.

Section II

Results of Multiple Regression

The result of the regression analysis suggest that in some cases surgical variations can be explained by medical supply factors (Table 16).

Table 15

Areas with High Rates for Surgical Procedures

Hospital Service Area	Hospital Serving the Area	Hysterect-tomy	Prostate-ctomy	Hernia Repair	Lens Extraction	Chole Cystectomy	Pacemaker Insertion	Total Hip Replacement
2	Lonesome	5.88	29.28	6.57	4.95	1.14	X	X
18	Bedford Hospital	4.12	19.42	2.36	9.45	2.42	.45	1.00
15	Radford Hospital	1.00	13.82	2.11	11.49	3.95	4.76	.30
23	Martinsville Memorial	1.61	18.43	2.09	8.02	4.49	1.14	1.56
17	Lewis-Gale	2.33	17.32	1.98	9.08	3.37	2.31	.86

Areas with Low Rates For Surgical Procedures

Hospital Service Area	Hospital Serving the Area	Hysterect-tomy	Prostate-ctomy	Hernia Repair	Lens Extraction	Chole Cystectomy	Pacemaker Insertion	Total Hip Replacement
1	Lee County Hospital	1.04	3.11	3.45	2.26	2.14	2.28	X
7	Tazewell Hospital	1.29	2.89	1.60	3.00	2.81	2.43	.35
8	Russell Medical Center	1.94	6.16	.75	4.84	2.24	X	.80
21	R.J.Reynolds Hospital	3.01	9.16	X	1.23	1.70	2.48	1.18
6	Buchanan General	1.75	13.86	1.19	2.75	1.89	1.02	X
	Median Rate	1.79	13.86	2.09	5.78	3.12	2.28	.57

Table 16

Results of Multiple Regression

Procedure	General Practitioner		Specialists		Beds		Occupancy Rate		Per Capita Expenditure		Proprietory Low Proprietory		R^2
	B	Beta	B	Beta	B	Beta	B	Beta	B	Beta	B	B	
Cholecystectomy	.98*	.68	--	--[1]	.02	.18	.07*	.4	-8.77	8.04-.03	.14	.03	.69*
Hernia Repair	.16	.17	--	--[1]	.022	.03	.01	.14	.004	.28	.18	.05	.11
Prostatectomy	1.94	.43	.62	.15	0.2	.21	.21	.49	-.01	-.15	-.14	-.17	.85*
Lens Extraction	1.24	.35	4.4	.42	.003	.01	.02	.07	.02	.59	-2.2	-.33	.67
Total Hip Replacement	.74	.93	.19	.08	-.01	-.22	.03	.45	-.005	-.39	.04	.02	.56
Pace Maker	.05	.03	--	--[2]	--	--[2]	-.05	-.46	-.001	-.08	-.50	-.17	.17
Hysterectomy	.27	.24	.41	.25	-.002	-.33	.01	.21	-.009	-.54	.66	.31	.38

*Significant at .05 level
Beta - Standardized B

1. No data since the two procedures did not require the services of the specialists.
2. Blanks creating during the execution of the procedure.

For most of the procedures, the regression model did not explain variations in surgical rates at significant level of .05, despite the fact that R^2 values for four procedures exceeded .50. The small number of observations was the principal reason for the lack of statistical significance in most procedures. It is to be remembered that the sample had only 23 cases. However, the results are still worth considering because of the high R^2 values for some of the procedures. The R^2 values make it possible to draw some conclusions about the relationships in the model.

For two procedures, i.e., cholecystectomy (.59) and prostatectomy (.85), R^2 were high and were significant at .05 level. For total hip replacement and lens extraction the R^2 values were moderately high (.56 and .67 respectively) but were not statistically significant. For two other procedures pacemaker insertion and hysterectomy (.17 and .38 respectively) the R^2 values were low and statistically not significant. For inguinal hernia repair, the R^2 value was low but this was expected because it was a nonelective procedure.

Of the six independent variables, three - hospital beds, per capita expenditure and ownership status - were universally not important predictors of surgical variations. The standardized regression coefficients were low in all cases, and for some procedures they were negative while for others they were positive. It was not possible to predict how these variables influenced surgical utilization.

Three variables were related to surgical rates for some procedures. They were: supply of general physicians and of specialists and hospital occupancy rate.

General physicians and specialists: For five procedures (cholecystectomy, prostatectomy, lens extraction, total hip replacement and hysterectomy) the supply of general physicians were predictors of surgical variations. Supply of specialists was a determinant of surgical variations in only two procedures - hysterectomy and lens extraction. The difference in the impact of general physicians and specialists may have been that in most service areas, on a per capita basis, general physicians far outnumbered the specialists, and in some areas they were the only physicians giving medical care. This could also explain why areas that were high in total surgical activity had high rates for most of the study procedures.

Occupancy Rate: Occupancy rate was a predictor of surgical variations in four procedures - cholecystectomy, prostatectomy, total hip replacement and hysterectomy. It is noteworthy that occupancy rate had greater explanatory power than the supply of beds. It suggests that a hospital's

ability to fill its beds is more important that the size of the hospital in influencing surgical behaviors. This raises questions about previous results (Lewis, 1960; Vayda et al., 1979) in which the supply of beds was found to be determinants of surgical variations. If occupancy rate had been considered, a stronger relationship with surgical rates might have been apparent.

Summing up, it could be said that the regression model produced a mixed bag of results. Whether a bigger sample would have produced a more statistically significant results is a moot point. At their present value, the regression model could not be unilaterally applied to all procedures. While three of the variables (per capita expenditures, bed supply and ownership status) proved to be of little importance, occupancy rate, supply of general physicians and specialists were shown to be determinants of variations in some procedures. Despite the unevenness of results, two important findings have emerged out of the study.

First, occupancy rate of hospital was more significant than the supply of hospital beds. In the past, some of the researches on surgical variations had found positive correlation between supply of beds and surgical utilization. However, these researchers did not take occupancy rate into account. In the current research where supply of beds was tested along with occupancy rate, supply of beds seemed to have no impact on surgical variations. It is possible that instances where bed supply alone was tested, bed supply was a surrogate measure for occupancy rate. Current results suggest that whether an area experiences more or less surgery does not depend on per capacity number of beds but whether the hospital serving the areas had a low or occupancy rate. The results also suggest that mere regulation of supply of beds would not lessen the variations in surgical utilization between service areas.

In terms of physician supply, it was found that for some procedures at least, areas that had more physicians per capita, experienced more surgery. The results were particularly definitive in case of general physicians. The results do seem to conform the hypothesis that areas with more physicians performing would experience more surgery.

Chapter V

Discussion

The purpose of this study was to determine if surgical variations existed among the hospital service areas of south-west and central Virginia and to analyze whether variations were due to medical supply factors. Data analyses showed variations in the rates of seven procedures among the hospital service areas. The areas also differed considerably on total surgical activity. However, it was not apparent that these variations were caused by demand inducement. Only certain variables, such as occupancy rate, general physicians and specialists proved to be determinants of surgical variations for some procedures. Thus, there are still some gaps in our understanding of the causes of surgical variations. The failure of the model to explain variations for all the procedures could have been caused by: (1) the limitations of data; (2) differing surgical practices; (3) socioeconomic and occupational characteristics of the service area populations.

Data Limitations

As noted before, the number of observations in the sample were not high enough to produce statistically significant results. Hence, a bigger sample might have produced better results. However, the absence or presence of relationship are not affected by sample size. The results of multiple regression had shown that (a) model as a whole was not successful in explaining variation for two elective procedures (hysterectomy and pacemaker) and (b) three variables had no influence at all on surgical rates. Under these circumstances, we have to consider the possibility that variations between hospital service areas could have been caused by factors outside the demand inducement model.

Differing Practice Styles

Some physicians may prefer surgery over other forms of therapies and decisions may cause some areas to experience more surgeries than others. This assumption is supported by evidence in our study, where areas with high or low rates for one surgical procedure had correspondingly high or low rates for most of the other procedures. This tendency, as indicated by the study, could be further reinforced in areas where general practitioners predominate and perform most of surgeries on the population.

Socio-Economic and Occupational Composition

Sometimes, differing practice styles could simply be a reflection of differing occupational and socio-economic characteristics of the service population. It is possible that population of some areas seek medical care more often than others, a tendency that could be reinforced by their occupation. For instance, mining workers, usually have a good health insurance and are used to regular medical care and because of the particular nature of their occupation prove to seek medical attention more often.[1] The habit of seeking medical care may continue in retirement also. There is some indication of this in the study, for three hospital service areas that were high in total surgical activity (HSA2, 4 and 5) were composed of predominantly mining communities.

Conclusion

Present study is the first of its kind to examine surgical variations for the population of Virginia. It is also one of a few that have looked into surgical utilization by the elderly population. It has been able to show that different areas experience different rates of surgery. The limitations

[1] I owe this observation to the insight of to one of the members of the committee, Ms. Pamela Cochran.

of the data analysis do not detract from the importance of some of the findings; (1) areas that have hospitals with low occupancy rate experience more surgery; (2) areas that have more physicians experience more surgery. These findings demonstrate the need for further statewide study of surgical variation among population groups. Such studies would provide better answers and thereby enable policy decisions to be formulated on issues relating to cost and effectiveness of surgical therapies.

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Appendix A

GEOGRAPHIC COMPOSITION OF HOSPITAL SERVICE AREAS

Hospital Service Areas	County	Towns & Cities	Hospital Serving The Area	Population (elderly)
1	Lee	Ben Hur, Blackwater, Dryden, Ewing Jonesville, Pennington Gap, Rose Hill, Saint Charles	Lee County Hospital	2626
2	Lee Wise	Keokee Appalachia, Big Stone Gap, East Stone Gap, Exeter, Stonegap	Lonesome Pine Hospital	1808
3	Wise	Andover, Pound, Wise, Coeburn	Norton Community Hospital	3490
	Dickenson	Nora	St. Mary's Hospital	
		Norton City	Park Avenue Hospital	
4	Dickenson	Trammel, Clintwood, Clincho	Wise Appalachian Regional Hospital	1085
5	Tazewell	Amonate, Bandy, Boisevain, Cedar Bluff, Doran, Jewell Ridge, Pocohontas, Richlands, Pounding Mill, Raven, Red Ash	Mattie William Hospital, Humana Clinch Valley Hospital	2620
	Buchanan	Jewell Valley, Whitewood, Pilgrims Knob, Rowe		
	Russell	Swards Geek		

Geographic Composition of Hospital Service Areas (continued)

Hospital Service Areas	County	Towns & Cities	Hospital Serving The Area	Population (elderly)
6	Tazewell	Yards	Buchanan General Hospital, Grundy Hospital	2541
	Buchanan	Big Rock, Conaway, Harman, Hurley, Keen Mountain, Mavisdale, Maxie, Oakwood, Vansant, Wolford, Patterson		
	Dickenson	Haysi, Birchleaf		
	Bland	Rocky Gap		
7	Tazewell	Bishop, Bluefield, Horsepen, North Tazewell, Tannersville Tayewell, Tiptop	Tazewell Community Hospital	2917
8	Russell	Castewood, Cleveland Honaker, Lebanon	Russell Community Hospital	2595
9	Grayson	Trout Dale	Smyth County Hospital	4851
	Smyth	Atkins, Broadford, Chilhowie, Marion Saltville Seven Mile Ford		
	Wythe	Rural Retreat		
10	Carroll	Cana, Dugspur, Fancy Gap, Hillsville, Hambsburg, Laurel Fork, Woodlawn	Twin County Hospital	6305
	Grayson	Elk Geek, Fries, Independence, Mouth of Wilson, Volney, Galax		

Geographic Composition of Hospital Service Areas (continued)

Hospital Service Areas	County	Towns & Cities	Hospital Serving The Area	Population (elderly)
11	Bland	Bastian, Bland, Ceres	Wythe County Hospital & Wytheville Hospital	3777
	Grayson	Whitetop		
	Wythe	Austinville, Cripple Geek, Crockett, Max Meadows, Speedwell, Wytheville, Ivanhoe		
12	Giles	Narrows, Pearisburg, Pembroke, Rich Creek, Ripplemead, Staffordsville	Giles Memorial Hospital	2575
13	Giles	Newport	Montgomery County Hospital	4573
	Montgomery	Blacksburg, Christiansburg, McCoy, Pilot		
14	Wythe	Barren Springs Foster Falls	Pulaski Community Hospital	2444
	Pulaski	Pulaski, Draper		
15	Floyd Montgomery Pulaski	Radford Alum Ridge, Riner, Belspring, Dublin, Hiwassee, New River, Newbern, Parrott	Radford Community	3279

Geographic Composition of Hospital Service Areas (continued)

Hospital Service Areas	County	Towns & Cities	Hospital Serving The Area	Population (elderly)
16	Floyd	Floyd, Willis	Roanoke	
	Covington	Memorial Clifton Forge	Hospital, CHRV	
	Alleghany	Iron Gate, Lowmoor	and Gill Memorial Hospital	
	Botetourt	Blue Ridge, Buchanan, Daleville		
	Bedford	Montvale, Goodview, Hardy, Villamont, Roanoke City		
	Roanoke	Bent Mountain, Vinton		
	Franklin	Boones Mill, Gladehill, Wirtz		
17	Floyd	Check, Copper Hill,	Lewis Gale	9565
	Montgomery	Elliston, Lafayette, Salem	Hospital	
	Craig	New Castle, Paint Bank		
	Alleghany	Selma		
	Botetourt	Cloverdale, Eagle Rock Fincastle, Troutville		
	Roanoke	Catawba		
18	Bedford	Goode, Huddleston, Howry, Moneta, Thaxton, Bedford City	Bedford County Hospital	3584

Geographic Composition of Hospital Service Areas (continued)

Hospital Service Areas	County	Towns & Cities	Hospital Serving The Area	Population (elderly)
19	Bedford	Forest, Big Island, Coleman Falls	Lynchburg General Hospital, and Virginia Baptist Hospital	15465
	Dickenson	Bee		
	Campbell	Altavists, Brookeneal, Concord, Evington, Gladys, Long Island, Lynch Station, Naruna, Rustburg		
	Amherst	Amherst, Madison Heights, Monroe, Sweet Briar		
	Pitsylvania	Hurt, Lynchburg		
	Appomattox	Appomattox, Evergreen, Pamplin, Spout Spring		
20	Franklin	Rocky Mount, Union Hall, Penhook, Henry, Ferrum, Callaway, Redwood	Franklin Memorial Hospital	2703
21	Pittsylvania Patrick	Dry Fork, Ararat Clandville, Crity, Meadows of Dan, Patrick Springs, Stuart, Vesta, Woolwine	R. J. Reynolds Hospital	1739

Geographic Composition of Hospital Service Areas (continued)

Hospital Service Areas	County	Towns & Cities	Hospital Serving The Area	Population (elderly)
22	Pittsylvania	Blairs, Callands, Cascade, Chattiam Gretna Java, Pittsville Ringgold, Sandy Level, Sutherline, Keeling Dawvitle	Danville Memorial Hospital	13018
23	Henry	Axton, Bassett, Collinsville, Fuldale, Ridgeway, Spencer, Stanleytown Martinsville	Memorial Hospital of Martinsville & Henry County	4359

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